

## **AMENDMENTS TO THE CLAIMS**

This listing of claims will replace all prior versions, and listings, of claims in the application:

### **Listing of Claims**

1. (Currently amended) A method ~~to synthesize a robust controller to~~ for controlling a ~~process of the type which may be modeled imperfectly~~ plant, said method comprising:
  - a. ~~providing an~~ generalized plant model as in a ~~prior-art~~ D-K iteration method ~~for synthesizing robust controllers~~, said generalized plant model comprising a nominal plant model, one or ~~a plurality of selected~~ more perturbation weightings, one or ~~a plurality of selected~~ more performance weightings, input ports, and output ports, said input ports configured for perturbation input, exogenous input, and control input, and said output ports configured for perturbation output, exogenous output, and control output, said control input and said control output corresponding to a controller to be designed;
  - b. providing a convex closed-loop map by applying a parameterization method on said generalized plant model, said convex closed-loop map being convex in terms of a free controller design parameter; said convex closed-loop map having a plurality of input channels corresponding to ~~the~~ said exogenous input and ~~the~~ said perturbation output of said generalized plant model, said convex closed-loop map having a plurality of output channels corresponding to ~~the~~ said exogenous output and ~~the~~ said perturbation input of said generalized plant model, said free controller design parameter being a stable system;
  - c. ~~providing a means for~~ optimizing a robust scaling for a robustness measure relating to said convex closed-loop map, while holding said free controller design parameter fixed, said robust scaling corresponding to ~~the robust~~ a scaling of said ~~prior-art~~ D-K iteration method, said robustness measure corresponding to a ~~robustness~~ measure of said ~~prior-art~~ D-K iteration method;
  - d. computing said free controller design parameter by formulating a controller optimization problem while holding said robust scaling fixed, said controller optimization problem relating to said robustness measure and ~~some~~ one or more other measures of said convex closed-loop map; and
  - e. iterating step c and step d until a stopping criterion is satisfied.

2. (Currently amended) The method ~~in~~ of claim 1 wherein ~~the~~ a frequency response of said robust scaling is optimized on a set of selected frequencies, and said ~~convex~~ controller optimization problem formulates said robustness measure on a number of said set of selected frequencies, based on a selected frequency gridding.

3. (Currently amended) The method ~~in~~ of claim 1 wherein said one or more perturbation weightings ~~is~~ are provided directly from a nonparametric estimate of ~~the~~ at least a modeling uncertainty of said nominal plant model on a finite number of selected frequencies.

4. (Currently amended) The method ~~in~~ of claim 1 wherein said ~~convex~~ controller optimization problem formulates said robustness measure on a set of selected frequencies based on frequency gridding, ~~the~~ decision variables of said controller optimization problem are ~~the~~ at least a frequency response of said free controller design parameter on said set of selected frequencies, and an ~~the~~ inverse discrete Fourier transform of said frequency response is constrained to be periodically stable.

5. (Currently amended) The method ~~in~~ of claim 1 wherein said ~~convex~~ controller optimization problem formulates said robustness measure on a set of selected frequencies based on frequency gridding, ~~the~~ and decision variables of said controller optimization problem are ~~the~~ coefficients of said free controller design parameter on said set of selected frequencies.

6. (Currently amended) The method ~~in~~ of claim 1 wherein said controller optimization problem ~~are~~ is changed during said iteration in step e.

7. (Currently amended) The method ~~in~~ of claim 1 wherein said parameterization method relates to Youla-parameterization.

8. (Currently amended) A method ~~to synthesize a robust controller to~~ for controlling a ~~process of the type which may be modeled imperfectly~~ plant, said method comprising:

a. ~~providing an~~ generalized plant model as in a ~~prior-art~~ D-K iteration method ~~for synthesizing robust controllers~~, said generalized plant model comprising a nominal plant model, one or ~~a plurality of selected~~ more perturbation weightings, one or ~~a plurality of selected~~ more performance weightings, input ports, and output ports, said input ports configured for perturbation input, exogenous input, and control input, and said output ports configured for perturbation output, exogenous output, and control output, said control input and said control output corresponding to a controller to be designed;

b. ~~providing a~~ convex closed-loop map by applying a parameterization method on said generalized plant model, said convex closed-loop map being convex in terms of ~~a free controller~~ a free controller design parameter; said convex closed-loop map having a plurality of input channels corresponding to ~~the~~ said exogenous input and ~~the~~ said perturbation output of said generalized plant model, said convex closed-loop map having a plurality of output channels corresponding to ~~the~~ said exogenous output and ~~the~~ said perturbation input of said generalized plant model, said free controller design parameter being a stable system;

c. ~~providing a means for~~ finding a robust scaling such that a robustness measure achieves a robustness level, said robust scaling corresponding to ~~the robust~~ a scaling of said ~~prior-art~~ D-K iteration method, said robustness measure corresponding to a robustness measure of said ~~prior-art~~ D-K iteration method; and

d. ~~computing~~ said free controller design parameter by formulating a controller optimization problem while holding said robust scaling fixed, said control optimization problem relating to said robustness measure, said robustness level, and ~~some~~ one or more other measures of said convex closed-loop map;

9. (Currently amended) The method in of claim 8 wherein the a frequency response of said robust scaling is optimized on a set of selected frequencies, and said ~~convex~~ controller optimization problem formulates said robustness measure on a number of said set of selected frequencies, based on a selected frequency gridding.

10. (Currently amended) The method in of claim 8 wherein at least one of said one or more perturbation weightings is provide directly from a nonparametric estimate of ~~the~~ at least a modeling uncertainty of said nominal plant model on a finite number of selected frequencies.

11. (Currently amended) The method ~~in~~ of claim 8 wherein said ~~convex~~ controller optimization problem formulates said robustness measure on a set of selected frequencies based on frequency gridding, ~~the~~ decision variables of said controller optimization problem are ~~the~~ at least a frequency response of said free controller design parameter on said set of selected frequencies, ~~the~~ and an inverse discrete Fourier transform of said frequency response is constrained to be periodically stable.

12. (Currently amended) The method ~~in~~ of claim 8 wherein said ~~convex~~ controller optimization problem formulates said robustness measure on a set of selected frequencies based on frequency gridding, ~~the~~ and decision variables of said controller optimization problem are ~~the~~ coefficients of said free controller design parameter on said set of selected frequencies.

13. (Currently amended) The method ~~in~~ of claim 8 wherein said parameterization method relates to Youla-parameterization.

14. (Currently amended) The method ~~in~~ of claim 8 wherein said ~~means for~~ finding said robust scaling involves ~~with~~ a direct search based on gridding of ~~the~~ a parameter space of said robust scaling.

15. (Currently amended) The method ~~in~~ of claim 8 wherein ~~step c~~ said ~~means for~~ finding said robust scaling comprises:

~~a.x.~~ providing a means for optimizing a robust scaling variable for said robustness measure relating to said convex closed-loop map, while holding said free controller design parameter fixed;

~~b.y.~~ computing said free controller design parameter by formulating a controller optimization problem while holding said robust scaling variable fixed, said controller optimization problem relating to said robustness measure;

~~c.z.~~ iterating step a x and step b y until a stopping criterion is satisfied.

16. (Currently amended) The method ~~in~~ of claim 8 wherein ~~step d~~ at least one input-output channel relating to said ~~some~~ one or more other measures of said convex closed-loop map is included in said robustness measure;

17. (Currently amended) The method ~~in~~ of claim 8 wherein ~~step d~~ ~~all the~~ input-output channels relating to said ~~some~~ one or more other measures of said convex closed-loop map, ~~and all the~~ are different from input-output channels of said robustness measure, ~~are different~~.

18. (Currently amended) A method ~~to synthesize a robust controller to~~ for controlling a ~~process of the type which may be modeled imperfectly~~ plant, said method comprising:

a. ~~providing an~~ generalized plant model as in a ~~prior-art~~ D-K iteration method for synthesizing ~~robust~~ controllers, said generalized plant model comprising a nominal plant model, one or ~~a plurality of selected~~ more perturbation weightings, one or ~~a plurality of selected~~ more performance weightings, input ports, and output ports, said input ports configured for perturbation input, exogenous input, and control input, ~~and~~ said output ports configured for perturbation output, exogenous output, and control output, said control input and said control output corresponding to a controller to be designed, at least one of said one or more perturbation weightings is provide directly from a nonparametric estimate of the modeling uncertainty of said nominal plant model on a finite number of selected frequencies;

b. providing a convex closed-loop map by applying a parameterization method on said generalized plant model, said convex closed-loop map being convex in terms of a free controller design parameter; said convex closed-loop map having a plurality of input channels corresponding to ~~the~~ said exogenous input and ~~the~~ said perturbation output of said generalized plant model, said convex closed-loop map having a plurality of output channels corresponding to ~~the~~ said exogenous output and ~~the~~ said perturbation input of said generalized plant model, said free controller design parameter being a stable system;

c. ~~providing a means for~~ optimizing a robust scaling for a robustness measure relating to said convex closed-loop map, while holding said free controller design parameter fixed, said robust scaling corresponding to ~~the robust~~ a scaling of said ~~prior-art~~ D-K iteration method, said robustness measure corresponding to a ~~robustness~~ measure of said ~~prior-art~~ D-K iteration method;

d.\_computing said free controller design parameter by formulating a controller optimization problem while holding said robust scaling fixed, said controller optimization problem relating to said robustness measure; and

e.\_iterating step c and step d until a stopping criterion is satisfied.

19. (Currently amended) A method ~~to synthesize a robust controller to~~ for controlling a process ~~of the type which may be modeled imperfectly~~, said method comprising:

a.\_providing ~~an~~ generalized plant model as in ~~a prior-art~~ a D-K iteration method for synthesizing ~~robust~~ controllers, said generalized plant model comprising a nominal plant model, one or ~~a plurality of selected~~ more perturbation weightings, one or ~~a plurality of selected~~ more performance weightings, input ports, and output ports, said input ports configured for perturbation input, exogenous input, and control input, and said output ports configured for perturbation output, exogenous output, and control output, said control input and said control output corresponding to a controller to be designed;

b.\_providing a convex closed-loop map by applying a parameterization method on said generalized plant model, said convex closed-loop map being convex in terms of a free controller design parameter; said convex closed-loop map having a plurality of input channels corresponding to ~~the~~ said exogenous input and ~~the~~ said perturbation output of said generalized plant model, said convex closed-loop map having a plurality of output channels corresponding to ~~the~~ said exogenous output and ~~the~~ said perturbation input of said generalized plant model, said free controller design parameter being a stable system;

c. ~~providing a means for~~ optimizing a robust scaling for a robustness measure relating to said convex closed-loop map, while holding said free controller design parameter fixed, said robust scaling corresponding to ~~the robust~~ a scaling of said ~~prior-art~~ D-K iteration method, said robustness measure corresponding to a robustness measure of said ~~prior-art~~ D-K iteration method;

d.\_computing said free controller design parameter by formulating a controller optimization problem while holding said robust scaling fixed, said controller optimization problem relating to said robustness measure, said ~~convex~~ controller optimization problem formulates said robustness measure on a set of selected frequencies based on frequency gridding, ~~the~~ decision variables of said controller optimization problem are ~~the~~ at least a frequency response of said free controller design parameter on said set of selected

frequencies, ~~the~~ at least an inverse discrete Fourier transform of said frequency response is constrained to be periodically stable; and

e. iterating step c and step d until a stopping criterion is satisfied.